CORRESPONDENCE/MEMORANDUM — State of Wisconsin

DATE: October 5, 2005   FILE REF: 4530

TO: Jon Heinrich – AM/7

FROM: John Roth – AM/7

SUBJECT: Air Dispersion Analysis for Obstructed Stacks and Fugitive Emissions in Support of Wisconsin's Air Toxic Rule

A. INTRODUCTION

A dispersion modeling analysis was completed on October 3, 2005 to assess the impact of the emissions from obstructed or non-vertical stacks, and fugitive emissions, on ambient air quality. This analysis was performed in support of Wisconsin's Air Toxics Rule, Chapter NR 445 of the Wisconsin Administrative Code.

B. MODELING PARAMETERS

♦ Four stack heights were considered in this analysis: 11.5 feet, 25 feet, 40 feet, and 75 feet above ground level. The inside stack diameters and temperatures were the same for all four stacks and also matched the threshold modeling used in the initial rule making (i.e. July 25, 2001 modeling memo from John Roth to Caroline Garber). For this analysis however, the exit gas velocity was set to 0.01 meters per second (m/s), the default value for an obstructed or non-vertical stack.

♦ In addition to the point sources, four area sources were considered in this analysis to reflect emissions from fugitive, or non-stack sources. Two areas were created, one 50 meters square and the other 100 meters square and each was modeled with two different source heights, 0 (zero) and one (1) feet above ground level.

♦ As was done for the threshold modeling for the air toxics rule development, four meteorological data sets, each containing five years of weather data were used. Thus, a total of twenty years of preprocessed National Weather Service (NWS) data were used in this analysis. Surface data was collected at the Eau Claire airport (1982-1986), the Green Bay airport (1983-1987), the Madison airport (1975-1979), and the Milwaukee airport (1982-1986). Concurrent upper air data was collected at the Green Bay NWS office and at the St. Cloud, Minnesota NWS office.

♦ The Industrial Source Complex Short Term 3 (ISCST3) model was also used in the analysis. The model used both urban and rural dispersion coefficients with the regulatory default options. The higher of the urban or rural concentration was used to establish the overall impact.

♦ The receptors used in this analysis consisted of a rectangular grid with one meter resolution starting at the stack and extending beyond the point of maximum impact. Due to the limitations on ISCST3, receptors closer than three times the building height were excluded. Specifically for the 11.5 foot stack, receptors began 10 meters from the source and extended 25 meters from the source. For the 25 foot stack, receptors began 19 meters from the source and extended to 25 meters from the source. For the 40 foot stack, receptors began 30 meters from the source and extended 35 meters from the source, and for the 75 foot stack receptors began 55 meters from the source and were placed every two meters out to 100 meters from the source.

♦ To be consistent with the 11.5 foot stack analysis, receptors for the area sources were placed no closer than 9 meters to the edge of the area and extended beyond the point of maximum impact to 15 meters from the edge of the area. To be consistent with the approach used previously in the analysis of stack emissions, no modeled concentrations were examined within the area source (even though ISCST3 allows this type of calculation).

NR 445 OBSTRUCTED STACK ANALYSIS STACK PARAMETERS				
	<25' Stack	25'-40' Stack	40'-75' Stack	>75' Stack
Stack Height (ft)	11.5	25.0	40.0	75.0
Stack Height (m)	3.51	7.62	12.19	22.86
Stack Diameter (ft)	1.00	1.00	1.00	1.00
Stack Diameter (m)	0.31	0.31	0.31	0.31
Exit Gas Velocity (m/s)	0.01	0.01	0.01	0.01
Exit Gas Temp (K)	293.0	293.0	293.0	293.0
Building Height (m)	3.05	6.10	9.75	18.29
Building Width (m)	10.00	10.00	19.50	36.58
Emission Rate (#/hr)	1.00	1.00	1.00	1.00

NR 445 FUGITIVE EMISSION ANALYSIS STACK PARAMETERS				
	50 m Area	50 m Area	100 m Area	100 m Area
Area Source Height (ft)	0.0	1.0	0.0	1.0
Area Source Height (m)	0.0	0.305	0.0	0.305
Length of Side (ft)	164.0	164.0	328.1	328.1
Length of Side (m)	50.0	50.0	100.0	100.0
Emission Rate (#/hr)	1.00	1.00	1.00	1.00

C.   MODELING RESULTS

The tables below detail the results of this analysis. The first table presents the results from the previous modeling done to establish the thresholds using a vertical unobstructed stack. Following this are tables detailing the impact from the obstructed or non-vertical stacks, and the ratio between their impact and the impact of the unobstructed stacks. Tables are then presented showing the impact of the area sources and the ratio between their impact and the impact of the <25' (11.5 foot) unobstructed stack.

UNOBSTRUCTED STACK RESULTS
(All Concentrations in μg/m3)

	<25' Stack	25'-40' Stack	40'-75' Stack	>75' Stack
1 Hour Concentration	1,339.2	420.5	218.7	81.5
24 Hour Concentration	446.8	115.0	57.0	14.8
Annual Concentration	49.3	12.0	5.04	1.43

OBSTRUCTED STACK RESULTS
(All Concentrations in μg/m3)

	<25' Stack	25'-40' Stack	40'-75' Stack	>75' Stack
1 Hour Concentration	1,735.0	1,571.0	528.7	111.1
24 Hour Concentration	486.6	246.4	82.4	17.8
Annual Concentration	81.7	22.2	7.0	1.7

OBSTRUCTED / UNOBSTRUCTED IMPACT RATIO

	<25' Stack	25'-40' Stack	40'-75' Stack	>75' Stack
1 Hour Concentration	1.296	3.736	2.417	1.363
24 Hour Concentration	1.089	2.143	1.445	1.199
Annual Concentration	1.658	1.851	1.394	1.157

AREA SOURCE RESULTS
(All Concentrations in μg/m3)

	50 m / 0.0 ft	50 m / 1.0 ft	100 m / 0.0 ft	100 m / 1.0 ft
1 Hour Concentration	2,540.0	1,076.0	2,354.0	1,075.0
24 Hour Concentration	826.2	293.8	767.0	278.2
Annual Concentration	161.2	64.6	151.0	61.7

AREA SOURCE / 11.5 FOOT UNOBSTRUCTED IMPACT RATIO

	50 m / 0.0 ft	50 m / 1.0 ft	100 m / 0.0 ft	100 m / 1.0 ft
1 Hour Concentration	1.897	0.803	1.758	0.803
24 Hour Concentration	1.849	0.658	1.717	0.623
Annual Concentration	3.270	1.310	3.063	1.252